

CLAIMS

What is claimed is:

1. A fixed abrasive tool, comprising:
 - a) a substrate; and
 - 5 b) a polishing layer attached to the substrate, said polishing layer comprising an organic matrix with nanodiamond particles therein.
2. The fixed abrasive tool of claim 1, wherein the polishing layer is formed in a predetermined three-dimensional pattern.
- 10 3. The fixed abrasive tool of claim 2, wherein the predetermined three-dimensional pattern includes projections.
4. The fixed abrasive tool of claim 3, wherein the projections are selected from the
15 group consisting of conical, frustoconical, pyramidal, frustopyramidal, cubic, parallelepiped, rectangular, cross, cylindrical, column, ridge, and combinations thereof.
5. The fixed abrasive tool of claim 3, wherein the projections are formed such that the fixed abrasive tool has a loading ratio of from about 0.05 to about 0.5.
- 20 6. The fixed abrasive tool of claim 1, wherein the nanodiamond particles have a particle size from about 1 nm to about 50 nm.
7. The fixed abrasive tool of claim 6, wherein the nanodiamond particles have a
25 particle size from about 2 nm to about 10 nm.
8. The fixed abrasive tool of claim 1, wherein the nanodiamond particles include a carbonaceous coating.

9. The fixed abrasive tool of claim 1, wherein the nanodiamond particles have a Moh's hardness greater than about 9.5.
10. The fixed abrasive tool of claim 1, wherein the nanodiamond particles are synthesized by an explosion synthesis process.
11. The fixed abrasive tool of claim 1, wherein the organic matrix comprises a member selected from the group consisting of epoxy, polyimide, polyethylene terephthalate, polytetrafluoroethylene, polyurethane, polycarbonate, polyester, and mixtures thereof.
12. The fixed abrasive tool of claim 1, wherein the substrate comprises a member selected from the group consisting of metals, polymers, and composites or alloys thereof.
13. The fixed abrasive tool of claim 1, wherein the fixed abrasive tool is configured as a CMP polishing pad.
14. A method of producing a fixed abrasive tool, comprising the steps of:
- a) providing a substrate;
 - b) preparing a slurry comprising nanodiamond particles and an organic binder;
 - c) forming the slurry on the substrate in a predetermined three-dimensional pattern; and
 - d) solidifying the slurry to produce abrasive projections including an organic matrix and nanodiamond particles.
15. The method of claim 14, wherein the step of forming is accomplished by screen printing.
16. The method of claim 15, wherein the step of forming further comprises repeated screen printing of slurry in adjacent layers to form the predetermined three-dimensional pattern.

17. The method of claim 14, wherein the step of forming is accomplished by tape casting a layer of slurry.
- 5 18. The method of claim 17, further comprising removing portions of the layer of slurry to produce the predetermined three-dimensional pattern.
19. The method of claim 14, wherein the predetermined three-dimensional pattern includes projections.
- 10 20. The method of claim 19, wherein the projections are selected from the group consisting of conical, frustoconical, pyramidal, frustopyramidal, cubic, parallelepiped, rectangular, cross, cylindrical, column, ridge, and combinations thereof.
- 15 21. The method of claim 14, wherein the step of solidifying is accomplished by curing.
22. The method of claim 14, wherein the slurry further comprises a solvent.
23. The method of claim 22, wherein the step of solidifying is accomplished at least
20 partially by solvent removal.
24. The method of claim 14, wherein the organic binder comprises from about 30 vol% to about 95 vol% of the slurry.
- 25 25. The method of claim 14, wherein the nanodiamond particles include a carbonaceous coating.
26. The method of claim 14, wherein the organic matrix is soluble in a polishing liquid.
- 30 27. A method of removing material from a workpiece, comprising the steps of:

- 5 a) providing a fixed abrasive polishing pad including a polishing layer having an organic matrix with nanodiamond particles therein;
- b) providing a workpiece to be treated; and
- c) polishing a surface of the workpiece with the fixed abrasive polishing pad to produce a polished surface.

28. The method of claim 27, wherein the polishing layer is formed in a predetermined three-dimensional pattern.

10 29. The method of claim 28, wherein the predetermined three-dimensional pattern includes projections.

30. The method of claim 29, wherein the projections are selected from the group consisting of conical, frustoconical, pyramidal, frustopyramidal, cubic, parallelepiped, 15 rectangular, cross, cylindrical, column, ridge, and combinations thereof.

31. The method of claim 29, wherein the projections are formed such that the fixed abrasive tool has a loading ratio of from about 0.05 to about 0.5.

20 32. The method of claim 27, wherein the step of polishing includes applying pressure at from about 1 psi to about 100 psi.

33. The method of claim 27, wherein the step of polishing removes the material from the surface at a rate from about 10 Å/min to about 1000 Å/min.

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34. The method of claim 27, further comprising introducing a polishing liquid to the surface during the step of polishing, said polishing liquid being a moderate solvent for the organic matrix.

35. The method of claim 34, wherein said polishing liquid is substantially free of abrasive particles upon introduction to the surface.
36. The method of claim 34, wherein said polishing liquid dissolves the matrix at points
5 of contact at a rate from about 1 Å/min to about 100 Å/min.
37. The method of claim 27, wherein the polished surface has a surface roughness (Ra) less than about 1 nm.
- 10 38. The method of claim 37, wherein the polished surface has an Ra from about 2 Å to about 10 Å.
39. The method of claim 27, wherein the substrate comprises a member selected from the group consisting of metals, polymers, and composites or alloys thereof.
- 15 40. The method of claim 39, wherein the workpiece is a member selected from the group consisting of silicon wafers, integrated circuitry, gemstones, and hard drive platters.
41. The method of claim 27, wherein the fixed abrasive tool is configured as a CMP
20 polishing pad.